

Oral hygiene education in adolescence based on the Precaution Adoption Process Model

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Objective: The present study hypothesised that interventions based on the Precaution Adoption Process Model (PAPM) are more effective than the conventional approach in modifying oral hygiene behaviour in adolescents. **Method:** A stratified random sampling method was used with subject groups (classrooms) randomly allocated to a control or to one of intervention groups (conventional instruction or PAPM). Short-term and long-term results were assessed after 3 and 12 months. The study sample comprised 254 12-13 year olds whose plaque levels were assessed by two outcome measures, namely the Quantitative Plaque Percent Index and its derivative the Ratio of Plaque % Change. **Results:** Subject retention rate was 69%. The most substantial decrease in plaque scores was in the PAPM group (12% after 3 months, 18% after 12 months), while the smallest reduction was in the control group (4% after 3 months and 12% after 12 months). There was a trend of reduction in plaque levels ($p < 0.001$) in all study groups from baseline to the 12 month follow-up. **Conclusions:** The intervention based on the Precaution Adoption Process Model was only slightly more effective in changing adolescent oral hygiene behaviour as compared to the conventional approach. The positive change in the control group was unexpected and needs further exploration.

Key words: dental plaque index, adolescent, oral hygiene, health behaviour, Precaution Adoption Process Model

Introduction

Dental caries and periodontal disease are commonly associated with risk behaviour and maintenance of good oral hygiene is considered of key importance in oral health education (Savolainen *et al.*, 2005). Conventional oral health instruction has long been thought ineffective in changing behaviours and the importance of theory-based interventions in health education has been emphasised (Nutbeam and Harris, 2004). While medicine has broadly taken up theory-based approaches (Brewer and Rimer, 2008), dentistry has not adopted them widely with only three somewhat dated studies being identified in oral health education for adolescents (Brukiene and Aleksėjūniene, 2010) Therefore, the results of these studies may have limited applicability to today's adolescents.

Furthermore, research in the field of social theories continues and most psychological models have developed to meet the needs of the present generation. In medicine the stage models have been the most widely used for behaviour modification and provide a foundation for implementation, monitoring and evaluation of behavioural changes. One such model, the Precaution Adoption Process Model (PAPM), assumes that people go through stages before modifying their behaviours (Brewer and Rimer, 2008). The PAPM is distinctive in having seven stages from ignorance to action (Weinstein and Sandman, 2002), e.g. this model differentiates between individuals who are unaware of a given health risk, do not perceive themselves as personally susceptible to disease, and are deciding whether to adopt recommended protective behaviours or not. The PAPM emphasises that subjects

at different stages need different counselling and/or intervention methods in order to move to a higher level behavioural stage.

The timing of the intervention delivery is another key issue for success in health education (Petrie *et al.*, 2007). Socially-critical periods in human life may have particular importance in determining health status over the long-term, and early adolescence has been identified as the first period (Bartley *et al.*, 1997).

The present study hypothesised that interventions based on the Precaution Adoption Process Model are more effective in improving oral hygiene behaviour in adolescents than the conventional approach.

Methods

The study was approved by the Bioethics Committee of the Ministry of Health. All 12-13-year-old adolescents from 3 randomly selected secondary schools were invited to participate in the study. Prior to the study, written informed consent was obtained from both the adolescents and their parents or guardians. To reduce possible measurement bias (Hawthorne Effect), all clinical examinations were performed at a time not announced in advance to the participants.

A stratified random sampling method was used and 17 subject groups (classes) were randomly allocated either into a control or into one of the intervention groups (conventional instruction group or PAPM group). The short-term and long-term results were assessed after 3 and 12 months, respectively.

Plaque levels were assessed applying two outcome measures, namely the Individual Quantitative Plaque % Index (Aleksėjuniene *et al.*, 2006) and its derivative the Ratio of Plaque % Change. Calculations of both indices were based on digital images of disclosed dental plaque.

The Individual Quantitative Plaque % Index (IQPI) indicates the tooth areas covered with plaque as a percentage of the total tooth area. The IQPI value for an individual was obtained by summing the indices of each tooth and then dividing this sum by the number of teeth assessed. The Ratio of Plaque % Change was calculated to compensate for the expected inter-individual variation in baseline plaque levels, which implies that individuals with low and high baseline plaque levels had different room for improvement. Importantly, these two indices based on the same digital recordings differ in principle. The IQPI is a direct measure of the change in dental plaque levels, while the Ratio of Plaque % Change is a derived (calculated) measure about the relative change in plaque levels. The Ratio of Plaque % Change was calculated as follows for each of the 3 and 12 month follow-ups: $100 \times (IQPI_{Baseline} - IQPI_{Follow-up}) / IQPI_{Baseline}$.

All plaque recordings were taken and evaluated by one examiner (VB). In order to secure blinding, all digital images were coded prior to subsequent assessments.

The control group received no professional intervention. The conventional instruction group received an oral presentation comprising basic knowledge regarding aetiology, development and prevention of oral disease (causes of dental caries, role of fluoride, role of diet and proper oral hygiene methods). The PAMP group participants

were first assessed for their stage via their response to the Stage Assessment Questionnaire then they received tailored messages in oral health education according to their stage as outlined in Table 1.

The intra-examiner reliability was assessed by intra-class correlation comparing double recordings of 10 randomly-selected images. Independent sample t-test was used for the non-response analysis. For comparisons among the groups, One-way ANOVA with post-hoc Dunnett adjustment was used. For comparisons over time, One-way ANOVA with post-hoc Bonferroni adjustment or Paired-Sample t-test was employed. For non-normal distributions non-parametric equivalents were applied. No account was taken in the analysis of the randomisation being by cluster rather than by individuals. The level of statistical significance for all tests was set at $p < 0.05$. For all analyses the Statistical Package for the Social Sciences (PASW v18.0, Chicago, IL) was used.

Results

Baseline dental plaque assessments were available for all 254 participants. A comparison of PAMP, conventional instruction and control groups' plaque levels found no difference indicating that random allocation was successful (Table 2).

The final response rate was 69% after 42 (17%) participants refused to be re-examined at one and 37 (15%) at both follow-up visits. Non-response analysis showed no differences in mean baseline plaque levels between those retained and those lost to follow-up.

Table 1. The allocation of staging based on the Precaution Adoption Process Model

<i>Stage Descriptor</i>	<i>Response to the Adapted Stage Assessment Questionnaire*</i>	<i>Intervention appropriate to the stage</i>
1. Unaware of the importance of adequate oral hygiene.	Not applicable.	Not applicable.
2. Unengaged in establishing adequate oral hygiene.	Yes, I forget to brush my teeth twice a day, but I do not think about it.	Basic knowledge regarding the aetiology, development and prevention of oral diseases.
3. Deciding to establish adequate oral hygiene.	Yes, I forget to brush my teeth twice a day, but I do not know if I should change anything. Yes, I forget to brush my teeth twice a day, but I will start to brush my teeth twice a day some time later.	Shown digital pictures of their own teeth stained to reveal plaque and received a motivational message to adhere to an oral hygiene regimen emphasising the social rather than the health-related consequences of oral health behaviour.
4. Decided not to establish adequate oral hygiene.	Yes, I forget to brush my teeth twice a day, but I will not change anything.	As stage 2.
5. Decided to establish adequate oral hygiene.	Yes, I forget to brush my teeth twice a day, but I will start to brush my teeth twice a day tomorrow.	Personal instruction in self-efficacy in oral hygiene.
6. Practicing adequate oral hygiene.	I never forget to brush my teeth twice every single day (specify for how long).	No intervention unless their self-reported oral hygiene behaviour was not in accordance with their objectively-evaluated oral hygiene status. In which case the participant was re-assigned to the latter stage and received the corresponding intervention.
7. Maintaining adequate oral hygiene.	I never forget to brush my teeth twice every single day (specify for how long).	As stage 6.

* Adolescents were asked a single question: "Do you sometimes forget to brush your teeth twice a day? Please choose only one statement" (Weinstein and Sandman, 2002)

Table 2. The Individual Quantitative Plaque % Index in the examinations of the groups

Groups	Baseline		3 month follow-up			12 month follow-up		
	n	mean % (sd)	n	mean % (sd)	p-value*	n	mean % (sd)	p-values*
PAPM**	89	42 (21)	68	30 (21)	0.008	53	24 (19)	<0.001
Conventional instructions	84	43 (21)	74	36 (21)	0.036	60	25 (19)	<0.001
Control	81	39 (18)	75	36 (19)	0.472	62	28 (20)	0.001
p-values#		0.481		0.199			0.752	

Comparisons among groups One-way ANOVA with post hoc Dunnet adjustment

* Comparisons over time One-way ANOVA with post hoc Bonferroni adjustment

** Precaution Adoption Process Model

Table 3. The Ratio of Plaque % Change in the examinations of the groups

Follow-up	PAPM*		Conventional instruction		Control		p-values#
	n	mean % (sd)	n	mean % (sd)	n	mean % (sd)	
Short-term (3 months)	68	32 (31)	74	15 (32)	75	-3 (57)	<0.001
Long-term (12 months)	53	43 (32)	60	35 (46)	62	27 (53)	0.612
p-values**		0.017		0.001		<0.001	

Comparison among groups Kruskal-Wallis test

* Precaution Adoption Process Model

** Comparisons over time Paired-Samples t test

The intra-class correlation coefficient was used to compare repeated recordings of ten digital images. A coefficient of 0.91 was considered an acceptable level of intra-examiner reliability.

Table 2 presents comparisons among groups for the Individual Quantitative Plaque % Index. Although there was a clear trend of reduction in plaque levels in all groups at both follow-up examinations, levels of plaque reduction did not differ between the intervention groups (conventional and PAPM) and the control group both at 3 and 12 month follow-up.

Table 3 presents comparisons between groups at different follow-up periods for the Ratio of Plaque % Change. There was a difference between the groups at the 3 month follow-up period when the PAPM group showed a large improvement and the control group observed small deterioration but with large variations between individuals within all groups. There were no differences at the 12 month follow-up.

There was a clear and highly statistically significant trend of reduction in plaque levels from baseline to the 12 month follow-up. Overall reductions of 8% were observed at the 3 month follow-up and by almost 16% at 12 month follow-up.

Discussion

The study hypothesised that the theory-based (the Precaution Adoption Process Model) intervention would be superior to the conventional approach in modifying the oral health behaviour of adolescents. While the PAPM intervention produced a steeper initial reduction in plaque levels, measured as a percentage change, there were no differences between interventions or with the control group in the longer term or using other measures. The improvements for all groups continued after the interven-

tions were discontinued. In contrast, previous studies have shown that positive behaviour change can be maintained only when reinforcement is in place (Redmond *et al.*, 1999). This bears further investigation.

Three previous (Albino, 1978; Albino *et al.*, 1977; Sogaard *et al.*, 1987) studies found theory-based interventions to be only slightly more effective than conventional approaches. These studies had only 3-12 week follow-up periods despite the need for oral hygiene to be maintained over years rather than over weeks (Renz *et al.*, 2007). Thus, the one-year follow-up of the present study may be considered an advantage.

Potential limitations of the present study should also be considered. Sample size calculations were impossible *a priori* as there are no similar theory-based behavioural studies in oral research and the study used a new outcome measure.

The Stage assessment questionnaire was chosen to allocate adolescents into stages of preparedness for oral health-related behaviour change for the pragmatic reason that it requires only a single question to assess a person's stage (Weinstein and Sandman, 2002). Although the staging approach was tested in many medical studies, (Brewer and Rimer, 2008) it has not been tested in oral studies. While innovative this can be considered a limitation as there is no previous validation in oral research. Using the Stage assessment questionnaire, one might expect people to overstate their interest in socially desirable actions; therefore, we considered a written anonymous method as superior to verbal assessment (Weinstein and Sandman, 2002).

Steps had been taken to reduce any Hawthorne effect or social desirability (Adair, 1984) as neither the adolescents nor school staff knew in advance when the oral hygiene assessments would take place, and as children did not have their toothbrushes at schools they could

not brush their teeth before the follow-up examinations. Another potentially confounding effect can not be ruled out: the carry over effect. To enhance comparability between the intervention and the control groups, individuals for both groups were recruited from the same schools. Another possibility is that disclosing of plaque, carried out three times for plaque assessment on all subjects, might have a motivating effect towards improvement of oral hygiene in the long term. Disclosing dental plaque might itself be considered “an intervention” particularly as each adolescent then received an individual report on the adequacy of their oral hygiene. A final possibility is that maturation was a factor in improving their oral health-related behaviours.

Future well-designed clinical-controlled studies focusing on behaviour change should specifically address the issue of why and how children without professional intervention improve just by being among individuals who have this type of intervention. Another question for future research is to examine whether disclosing plaque alone has the effect of improving children’s oral hygiene.

The loss of participants in follow-up periods is a common problem encountered in longitudinal studies, though the retention rate of 69% achieved in this study is adequate. Non-response analysis showed no differences in mean baseline plaque levels between those present and those absent at follow-ups so it is unlikely that loss to follow up influenced findings.

Randomising individuals into groups was considered inappropriate for the purpose of this study as having individuals from different groups in the same school class might encourage the carry-over effect of the interventions to individuals in the control group. Therefore, school classes (clusters) were randomly allocated to the groups rather than individuals. Lack of difference in baseline dental plaque levels between groups suggests randomisation was successful.

The study used a single examiner to avoid the inter-examiner variability. The high level of intra-examiner reliability (intra-class correlation coefficient=0.9) indicated reliable assessment. Further, blind-to-intervention assessment of digital images using an interval scale was a clear advantage over previous studies’ categorical measurements (Brukiene and Aleksejuniene, 2009) as a few categories of oral hygiene measure may be insufficient to capture variation between and among individuals.

Conclusions

The intervention based on the Precaution Adoption Process Model was only initially slightly more effective in changing adolescent oral hygiene behaviour as compared to the conventional approach or no intervention. The positive change in all groups was unexpected and needs further exploration.

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References

- Adair, J.G. (1984): The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology* **69**, 334-335.
- Albino, J.E. (1978): Evaluation of three approaches to changing dental hygiene behaviors. *Journal of Preventive Dentistry* **5**, 4-10.
- Albino, J.E., Juliano, D.B. and Slakter, M.J. (1977): Effects of an instructional-motivational program on plaque and gingivitis in adolescents. *Journal of Public Health Dentistry* **37**, 281-289.
- Aleksejuniene, J., Scheie, A.A. and Holst, D. (2006): Inter-individual variation in the plaque formation rate of young individuals. *International Journal of Dental Hygiene* **4**, 35-40.
- Bartley, M., Blane, D. and Montgomery, S. (1997): Health and the life course: why safety nets matter. *British Medical Journal* **314**, 1194-1196.
- Brewer, N.T. and Rimer, B.K. (2008): Perspectives in health behavior theories that focus on individuals. In: *Health Behavior and Health Education*, 4th edn; eds. Glanz, K., Rimer, B.K. and Viswanath, K. pp149-165. San Francisco: Jossey-Bass.
- Brukiene, V. and Aleksejuniene, J. (2009): An overview of oral health promotion in adolescents. *International Journal of Paediatric Dentistry* **19**, 163-171.
- Brukiene, V. and Aleksejuniene, J. (2010): Theory-based oral health education in adolescents. *Stomatologija* **12**, 3-9.
- Nutbeam, D. and Harris, E. (2004): *Theory in a Nutshell. A Practical Guide to Health Promotion Theories*. Sydney, Australia: McGraw-Hill Australia Pty Ltd.
- Petrie, J., Bunn, F. and Byrne, G. (2007): Parenting programmes for preventing tobacco, alcohol or drugs misuse in children <18: a systematic review. *Health Education Research* **22**, 177-191.
- Redmond, C.A., Blinkhorn, F.A., Kay, E.J., Davies, R.M., Worthington, H.V. and Blinkhorn, A.S. (1999): A cluster randomized controlled trial testing the effectiveness of a school-based dental health education program for adolescents. *Journal of Public Health Dentistry* **59**, 12-17.
- Renz, A., Ide, M., Newton, T., Robinson, P.G. and Smith, D. (2007): Psychological interventions to improve adherence to oral hygiene instructions in adults with periodontal diseases. *Cochrane Database Systematic Review*; (2):CD005097.
- Savolainen, J.J., Suominen-Taipale, A.L., Uutela, A.K., Martelin, T.P., Niskanen, M.C. and Knuutila, M.L. (2005): Sense of coherence as a determinant of toothbrushing frequency and level of oral hygiene. *Journal of Periodontology* **76**, 1006-1012.
- Sogaard, A.J., Tuominen, R., Holst, D. and Gjermo, P. (1987): The effect of 2 teaching programs on the gingival health of 15-year-old schoolchildren. *Journal of Clinical Periodontology* **14**, 165-170.
- Weinstein, N.D. and Sandman, P.M. (2002): The Precaution Adoption Process model and its application. In: *Emerging Theories in Health Promotion Practice and Research*; eds. DiClemente, R.J., Crosby, R.A. and Kegler, M.C. pp16-39. San Francisco: Jossey-Bass.